Sensitivity and Uncertainty Analysis to Burn-up Estimates on ADS Using ACAB Code

Oscar Cabellos[1], Jesus J. Ruiz[1], Javier Sanz[2], Arturo Rodriguez[2], Rafael Falquina[2],
Enrique Gonzalez[3], Miguel Embid[3], Francisco Alvarez[3]

[1] *UPM*
[2] *UNED*
[3] *CIEMAT*

For detailed ADS design calculations the burn-up uncertainty estimates due to activation cross section uncertainties are important. We applied the sensitivity-uncertainty analysis to burn-up calculations in a lead-bismuth cooled subcritical Accelerator Driven System. Sensitivity-uncertainty methods provide a method to identify the nuclear cross sections and the dominant chains that contribute most significantly to the isotopic inventory. These uncertainty estimates are valuable to assess the need of any experimental re-evaluation. In this work, activation cross-section uncertainty data are taken from the FENDL and EAF2003 libraries.

ACAB code has the capability to perform a comprehensive sensitivity-uncertainty analysis in activation calculations. This procedure is based on a first order Taylor series approach, and in the use of original algorithms to compute efficiently the partial derivatives. Sensitivity coefficients of nuclide concentrations to reaction cross sections are obtained and then combined with the uncertainty information to calculate uncertainty estimates of the isotopic inventory. This methodology is found practical for providing the uncertainties of the different inventory response functions due to the uncertainties of each of the reaction cross sections separately. The most important limitation of the method is that it is impractical to deal with the synergetic/global effect of the uncertainties of the complete set of cross sections. To overcome this limitation, an uncertainty analysis methodology based on Monte Carlo has been implemented in ACAB. The Monte Carlo procedure is based on simultaneous random sampling of all the cross sections involved in the problem. The probability distributions of isotopic inventory (and estimate of the confidence level) are obtained with Monte Carlo method. We have also identified the critical cross sections and we evaluate the effect of a reasonable reduction in the uncertainties of the cross sections in order to obtain a reasonable reduction in this uncertainty.

Email: cabellos@din.upm.es